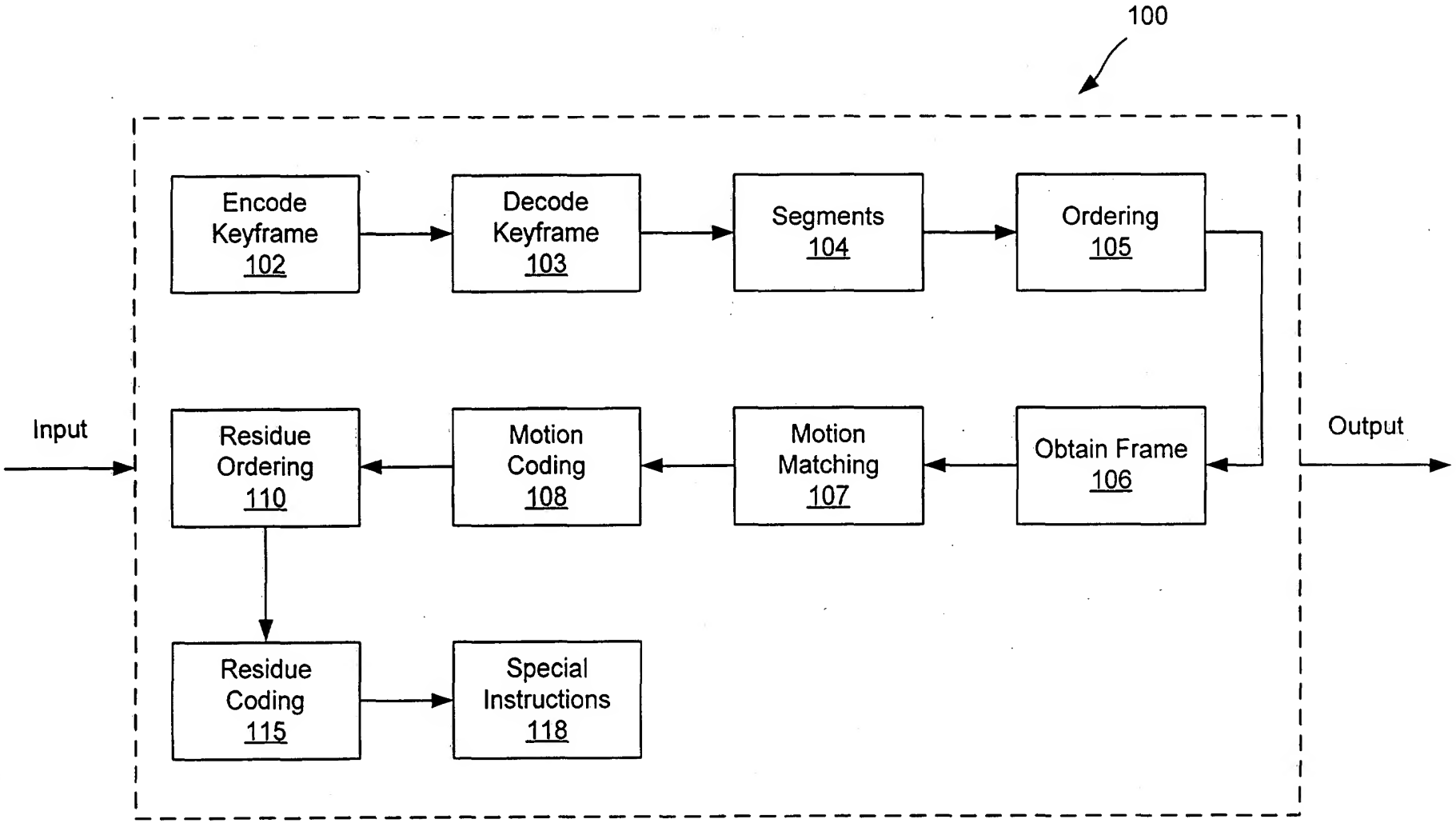
100
Encode Keyframe 102
Decode Keyframe 103
Segments 104
Ordering 105
Input
Residue Ordering 110
Motion Coding 108
Motion Matching 107
Obtain Frame 106
Output
Residue Coding 115
Special Instructions 118

FIG. 1

ENCODER DESCRIPTION

| | |
|---|---|
| 201 | The encoder obtains a reference image frame. |
| 202 | The encoder encodes the image frame from step 201 and transmits it to the decoder. |
| 203 | The encoded image from the previous step is reconstructed by the encoder, in the same manner as the decoder will. |
| 204 | The encoder determines the structural information, i.e.segments, the reconstructed image from step 204. Alternatively, the encoder segments the original reference image frame from step 201. |
| 205 | The segments determined in step 204 are ordered by the encoder, in the same manner as the decoder will. |
| 206 | The encoder obtains a new image frame. |
| 207 | The motion related information of each segment is determined by motion matching. |
| 208 | The encoder encodes the motion information. |
| 209 | Based on the motion information from step 208, previously hidden regions, also known as the background residue, in the first frame may be exposed in the second frame. |
| 210 | The encoder orders the background residue locations, in the same manner as the decoder will. |
| 211 | The encoder attempts to fill each of the background residue locations (i.e., predict the background residues) from steps 209 and 210; |
| 212 | The encoder determines the difference between the predicted fill and the actual fill for each of the background residue areas. |
| 213 | The encoder determines the local residue areas in the second image frame, from the segment motion information. |
| 214 | The encoder orders the local residues from step 213, in the same manner as the decoder will. |
| 215 | The encoder encodes the background and local residues from steps 212 and 214. |
| 216 | If the image can be reasonably reconstructed primarily from the motion information, with assistance from the background residue and the local segment residues, the encoder transmits the following information, and reconstructs the second frame, as the decoder will, and continues at step 206:<br>a. Flag denoting that the second frame is not a keyframe<br>b. The motion related information for the segments<br>c. Special instructions for segments<br>d. The background residue information with flags denoting coding<br>e. The local residue information along with flags denoting coding |
| 217 | If the image cannot be reconstructed in relation to the reference frame, the image is encoded as a key frame, a flag is transmitted to so inform the decoder, and the encoder continues at step 202. |

FIG. 2

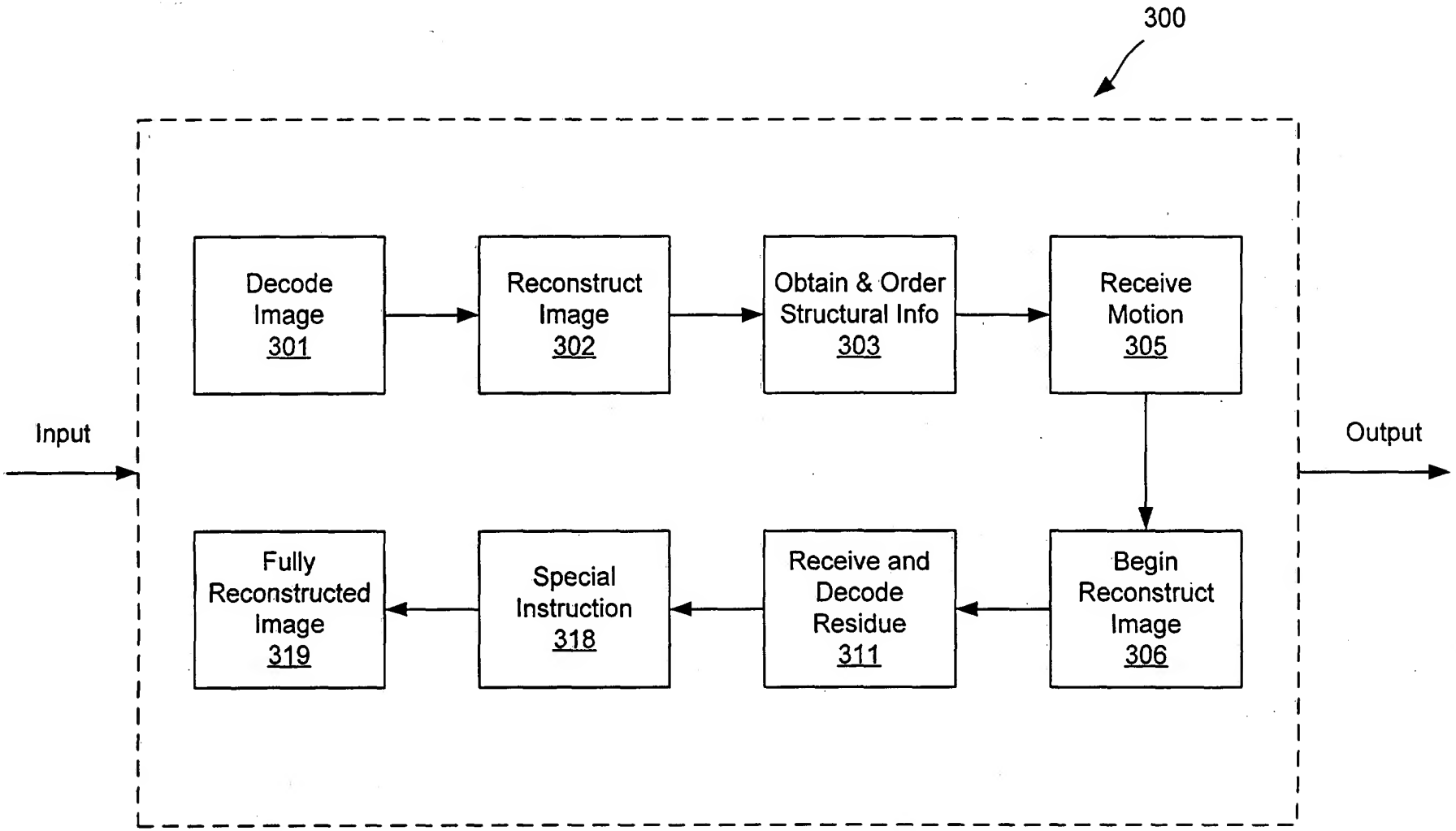
300
Decode Image 301
Reconstruct Image 302
Obtain & Order Structural Info 303
Receive Motion 305
Input
Output
Fully Reconstructed Image 319
Special Instruction 318
Receive and Decode Residue 311
Begin Reconstruct Image 306

FIG. 3

DECODER DESCRIPTION

| | |
|---|---|
| 401 | The decoder receives an encoded image frame. |
| 402 | The encoded image frame from step 401 is reconstructed by the decoder in the same manner as the encoder. |
| 403 | The reconstructed image frame from step 402 is segmented and ordered by the decoder in the same manner as the encoder. |
| 404 | The decoder receives a flag from the encoder stating whether the subsequent frame is a keyframe, i.e. not represented in relation to any other frame. If so, then the decoder returns to step 401. |
| 405 | The decoder receives motion related information regarding the segments determined in step 403 from the encoder. |
| 406 | The decoder begins to reconstruct a subsequent image frame using the segments obtained in step 403 and motion related information obtained in step 404. |
| 407 | Based on the motion related information from step 404 regarding the segments determined in step 403, the decoder determines where areas, previously hidden, are now revealed, also known as the background residue. |
| 408 | The background residue locations from step 406 are ordered in the same manner as by the encoder. |
| 409 | The decoder attempts to fill the background residue locations; thereby predicting the background residue information. |
| 410 | The decoder receives additional background residue information (i.e., relative to the predicted background residue) plus flags denoting the coding method for the additional background residue information from the encoder. |
| 411 | The decoder decodes the additional background residue information. |
| 412 | The computed background residue information and the additional background residue information is added to the second image frame. |
| 413 | Based on the motion information from step 404 regarding the segments determined in step 403, the decoder determines the location of the local segment residues, if any. |
| 414 | The local segment residue locations are ordered in the same manner as by the encoder. |
| 415 | The decoder receives coded local segment residue information plus flags denoting the coding method for each local segment residue location. |
| 416 | The decoder decodes the local segment residue information. |
| 417 | The decoded local segment residue information is added to the second frame. |
| 418 | The decoder receives any special instructions and adds them to the second frame. |
| 419 | Reconstruction of the second frame is complete. |
| 420 | If there are more frames, the routine continues at step 404. |

FIG. 4

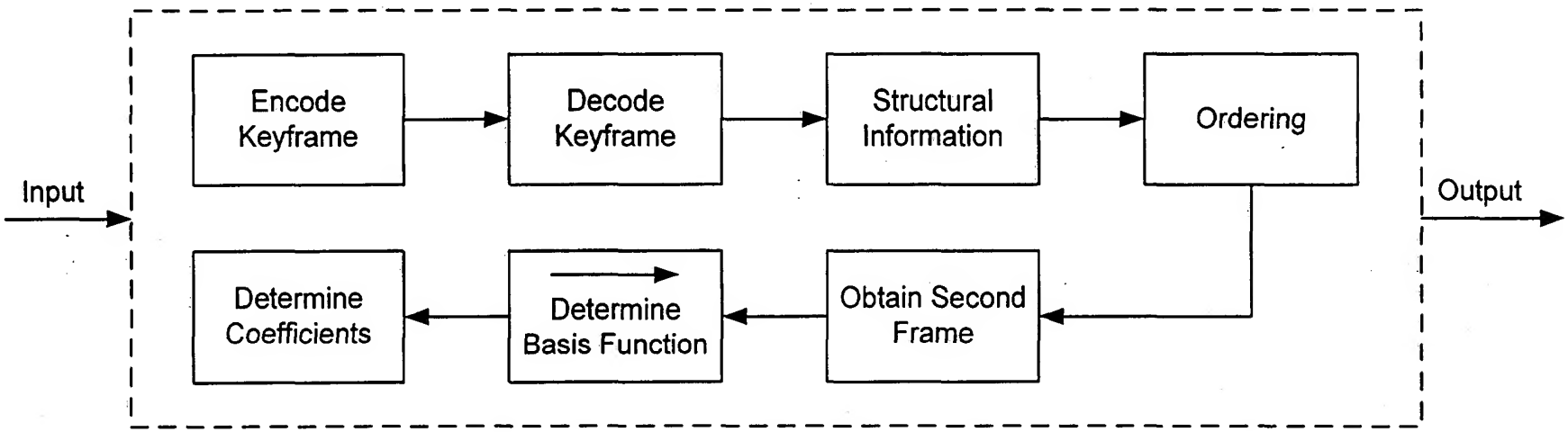
Input
Encode Keyframe
Decode Keyframe
Structural Information
Ordering
Output
Determine Coefficients
Determine Basis Function
Obtain Second Frame

FIG. 5A

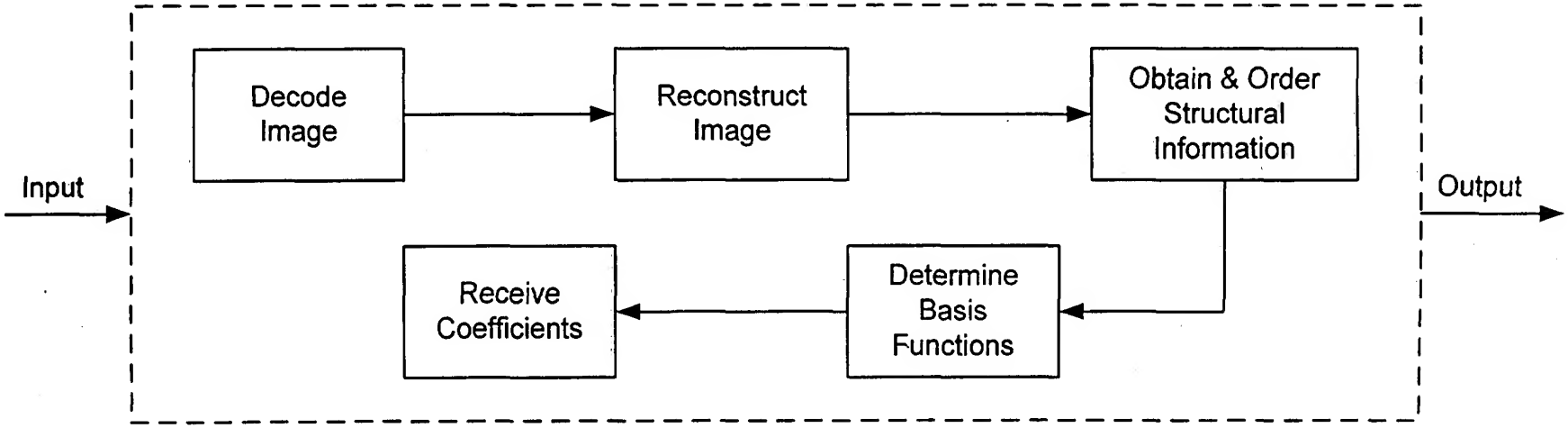
Input
Decode Image
Reconstruct Image
Obtain & Order Structural Information
Output
Receive Coefficients
Determine Basis Functions

FIG. 5B

ENCODER/DECODER SYSTEM

| | Encoder | | Decoder |
|---|---|---|---|
| | | | |
| 601 | Obtain, encode, transmit reference frame → | | Receive reference frame |
| 602 | Reconstruct reference frame | | Reconstruct reference frame |
| 603 | Obtain Structural Information | | Obtain identical Structural Information |
| 604 | Order segments | | Order segments |
| 605 | Obtain 2nd image frame | | |
| 606 | Determine motion relation information | | |
| 606a | Group by Multi-scaling and/or prediction from previous motion related information | | |
| 606b | Predict segment motion data | | |
| 607 | Encode any motion related information relative to grouping and prediction | | |
| 608 | Determine background residue | | |
| 609 | Order background residues | | |
| 610 | Predict background residue | | |
| 611 | Determine sufficiency of prediction | | |
| 612 | Determine local residue | | |
| 613 | Order local residue locations | | |
| 614 | Encode background and local residue | | |
| 615 | Is 2nd frame keyframe? If yes, go to step 601 → | | Receive keyframe flag |
| 616 | Transmit motion related information → | | Receive motion related information |
| 616a | | | Group segments by Multi-scaling and/or prediction from previous motion related information exactly as in step 606a. |
| 616b | | | Predict segment motion data as in step 606b. |
| 617 | | | Determine and order background and local residue locations exactly as in steps 608, 609, 612, and 613 |
| 618 | | | Predict background residue as in step 610. |
| 619 | Transmit background and local residue information → | | Receive background and local residue information |
| 620 | | | Decode background and local residue information |
| 621 | Transmit special instructions → | | Receive special instructions |
| 622 | Reconstruct 2nd Frame | | Reconstruct 2nd Frame |
| 623 | Go to step 605 | | Go to step 605 |

FIG. 6

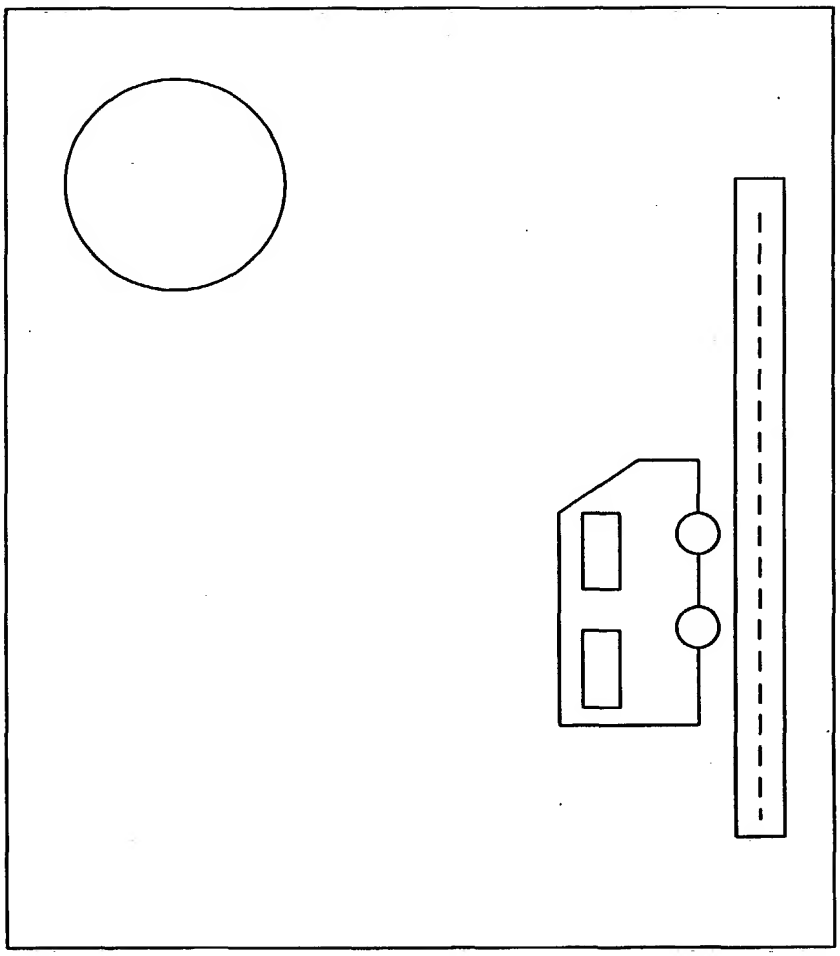

FIG. 7

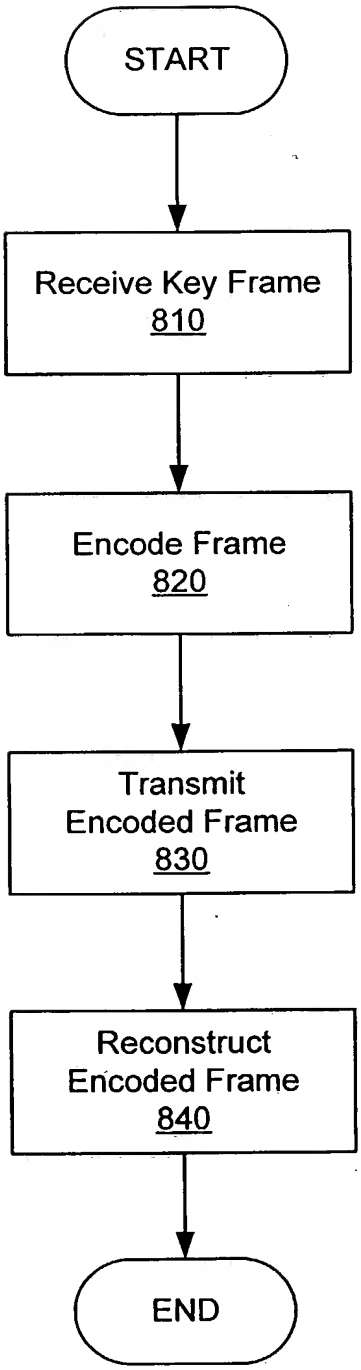
START
Receive Key Frame
810
Encode Frame
820
Transmit
Encoded Frame
830
Reconstruct
Encoded Frame
840
END

FIG. 8

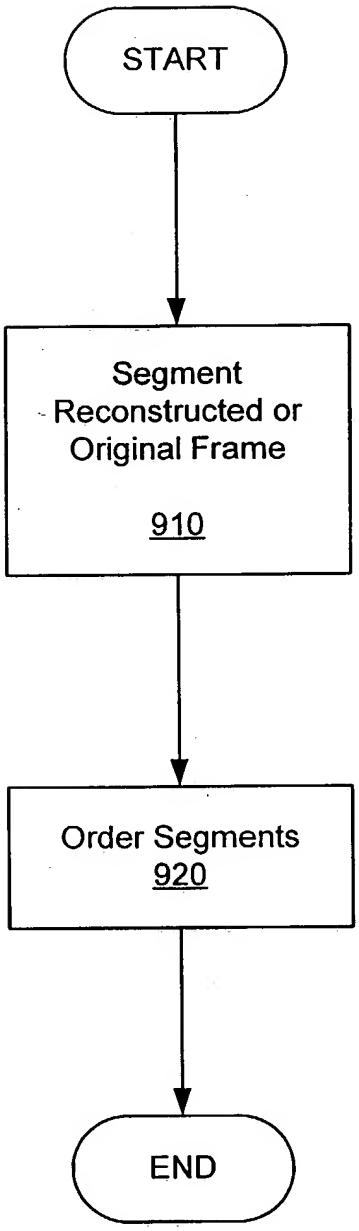
START
Segment Reconstructed or Original Frame
910
Order Segments
920
END

FIG. 9

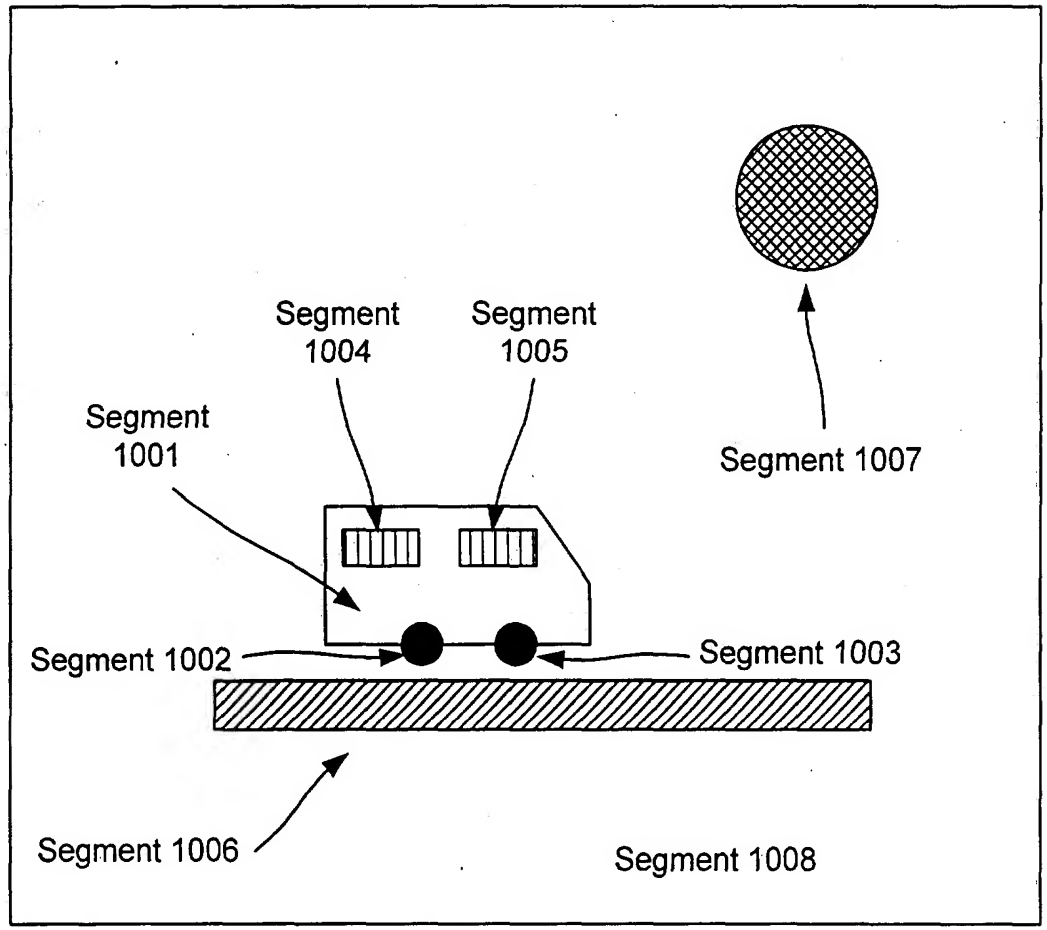
Segment 1004
Segment 1005
Segment 1001
Segment 1007
Segment 1002
Segment 1003
Segment 1006
Segment 1008

FIG. 10

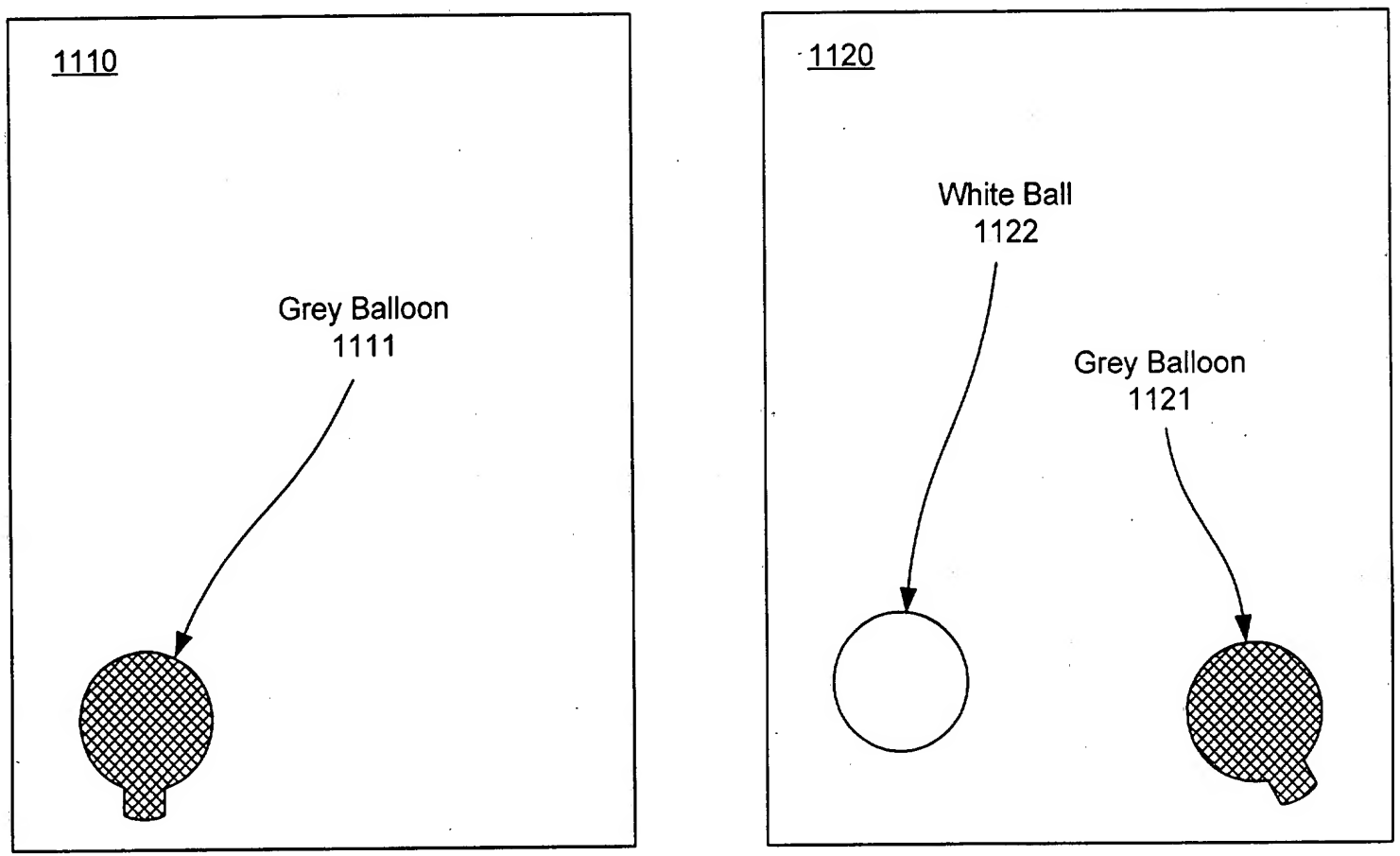
1110
Grey Balloon
1111
1120
White Ball
1122
Grey Balloon
1121

FIG. 11

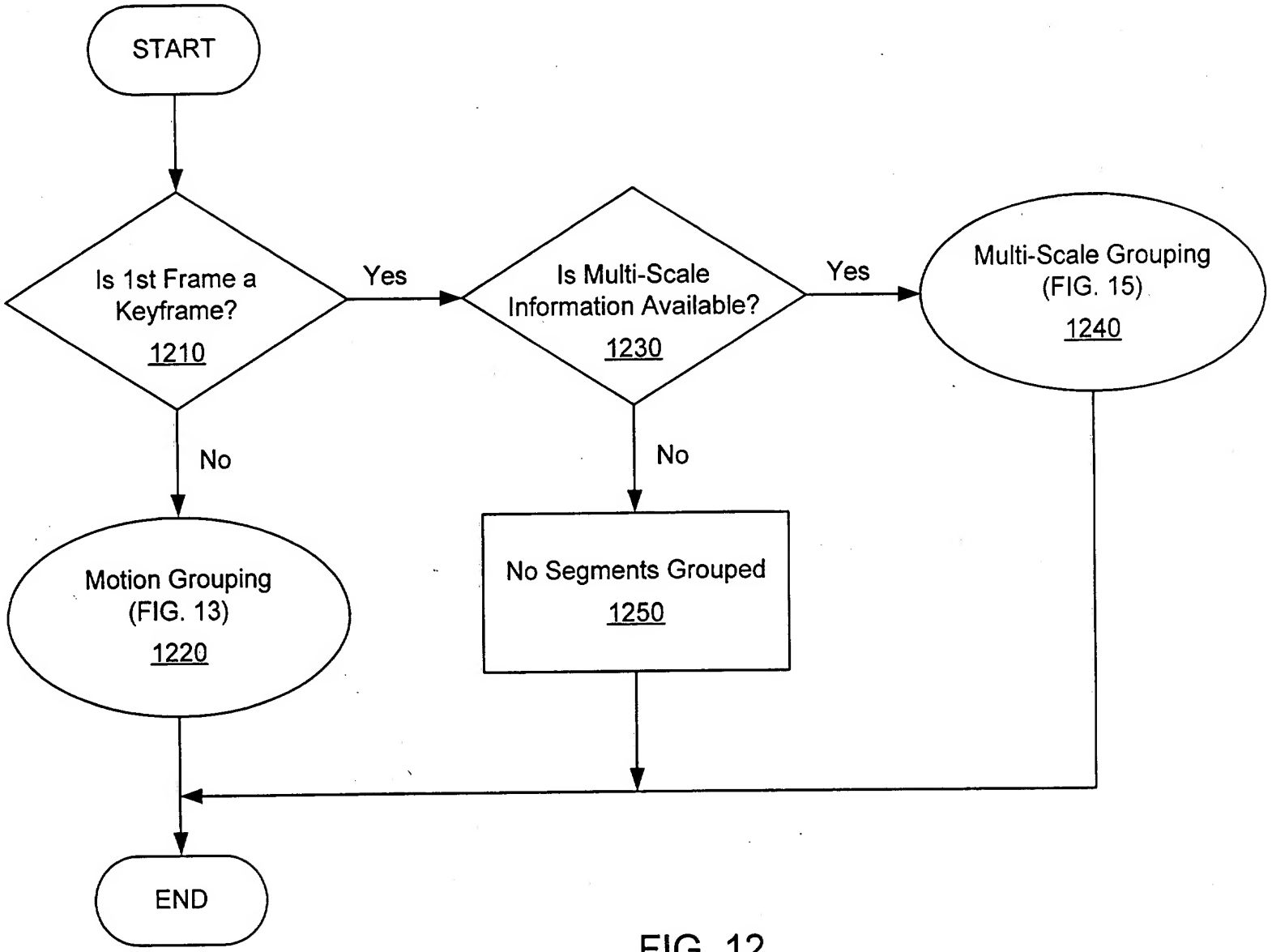
START
Is 1st Frame a Keyframe?
1210
Yes
Is Multi-Scale Information Available?
1230
Yes
Multi-Scale Grouping (FIG. 15)
1240
No
No
Motion Grouping (FIG. 13)
1220
No Segments Grouped
1250
END

FIG. 12

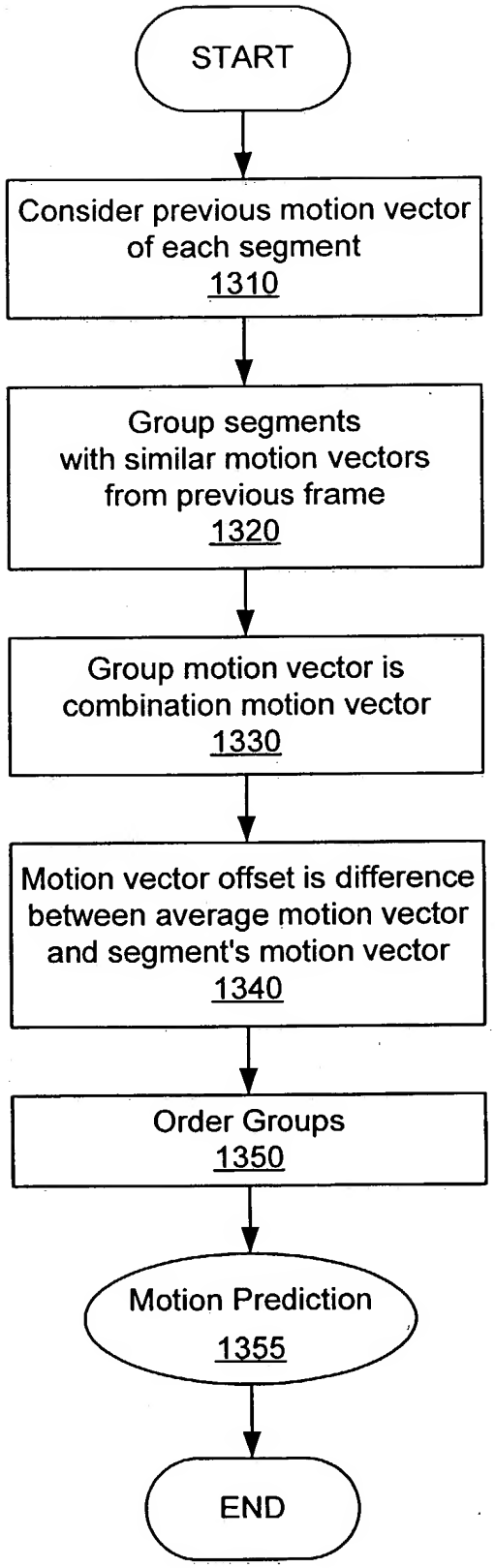
START
Consider previous motion vector of each segment
1310
Group segments with similar motion vectors from previous frame
1320
Group motion vector is combination motion vector
1330
Motion vector offset is difference between average motion vector and segment's motion vector
1340
Order Groups
1350
Motion Prediction
1355
END

FIG. 13

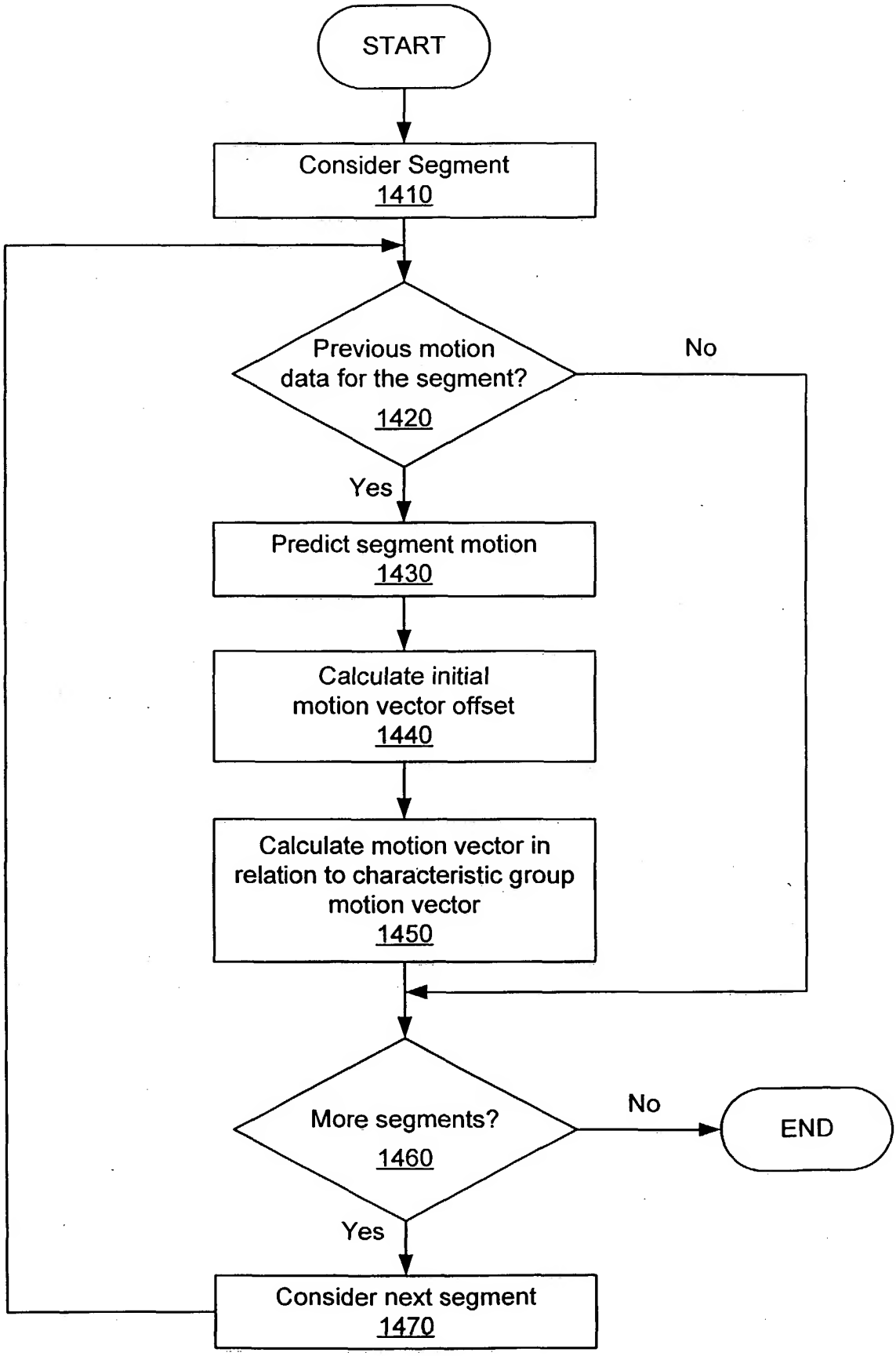
START
Consider Segment
1410
Previous motion data for the segment?
1420
No
Yes
Predict segment motion
1430
Calculate initial motion vector offset
1440
Calculate motion vector in relation to characteristic group motion vector
1450
More segments?
1460
No
END
Yes
Consider next segment
1470

FIG. 14

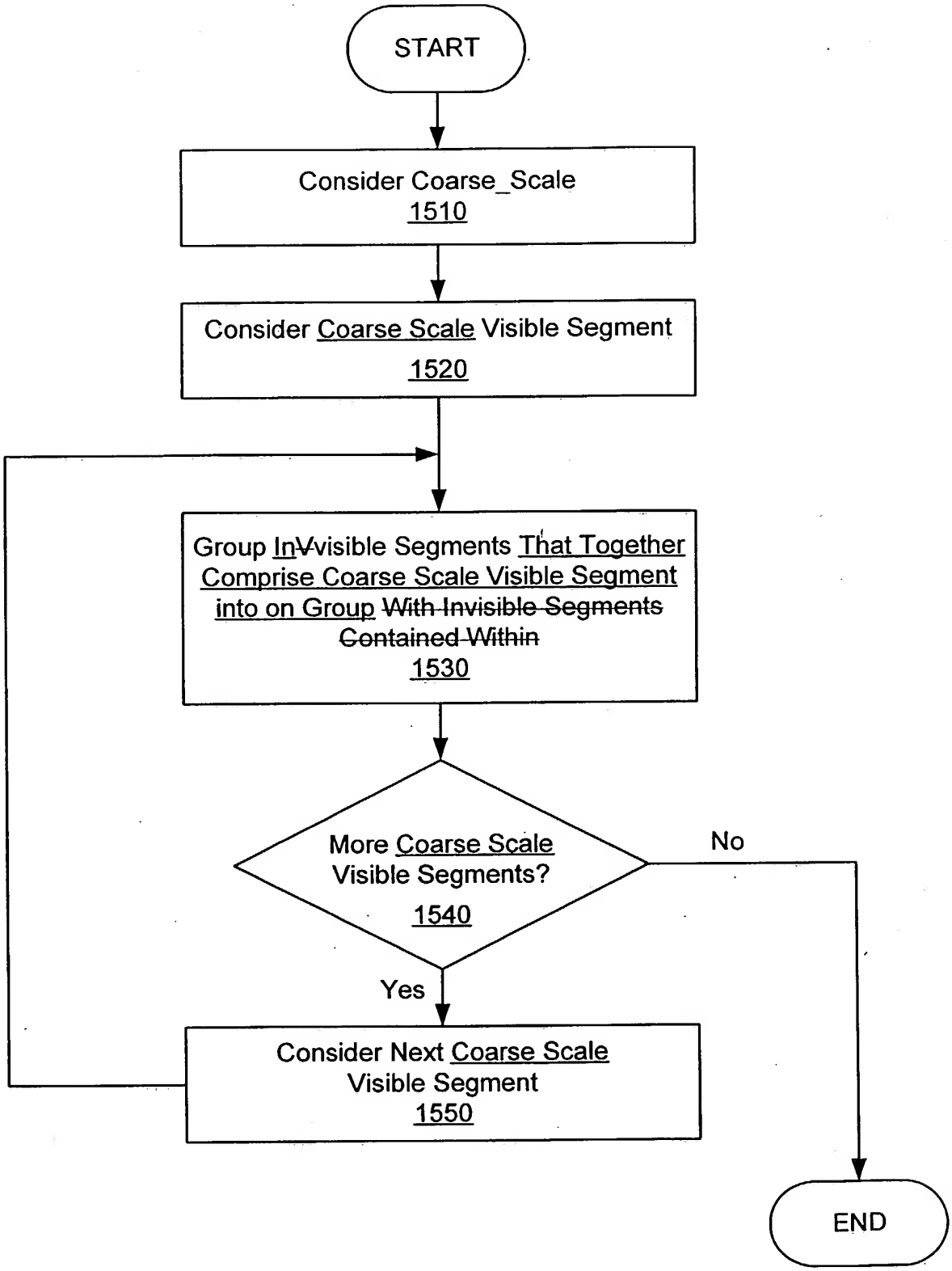
START
Consider Coarse_Scale
1510
Consider Coarse Scale Visible Segment
1520
Group In~~V~~visible Segments That Together Comprise Coarse Scale Visible Segment into on Group ~~With Invisible Segments Contained Within~~
1530
More Coarse Scale Visible Segments?
1540
No
Yes
Consider Next Coarse Scale Visible Segment
1550
END

FIG. 15

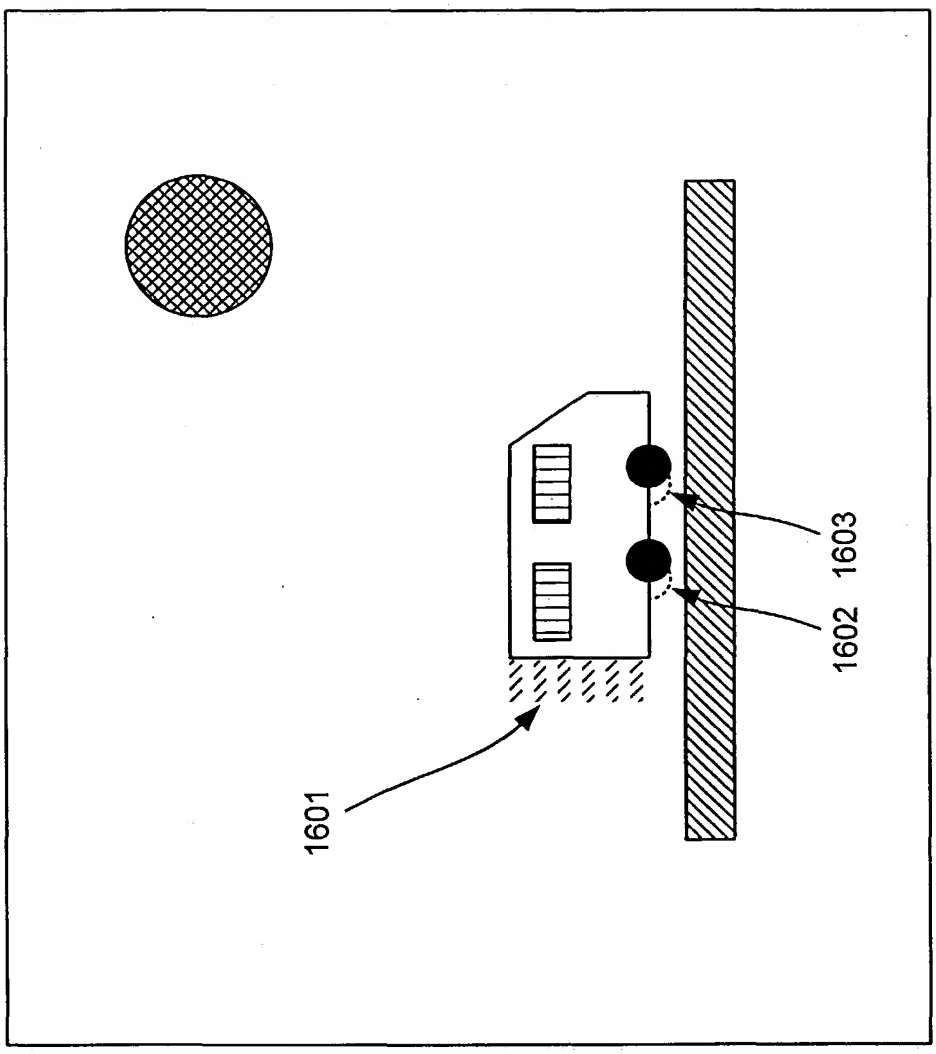


FIG. 16

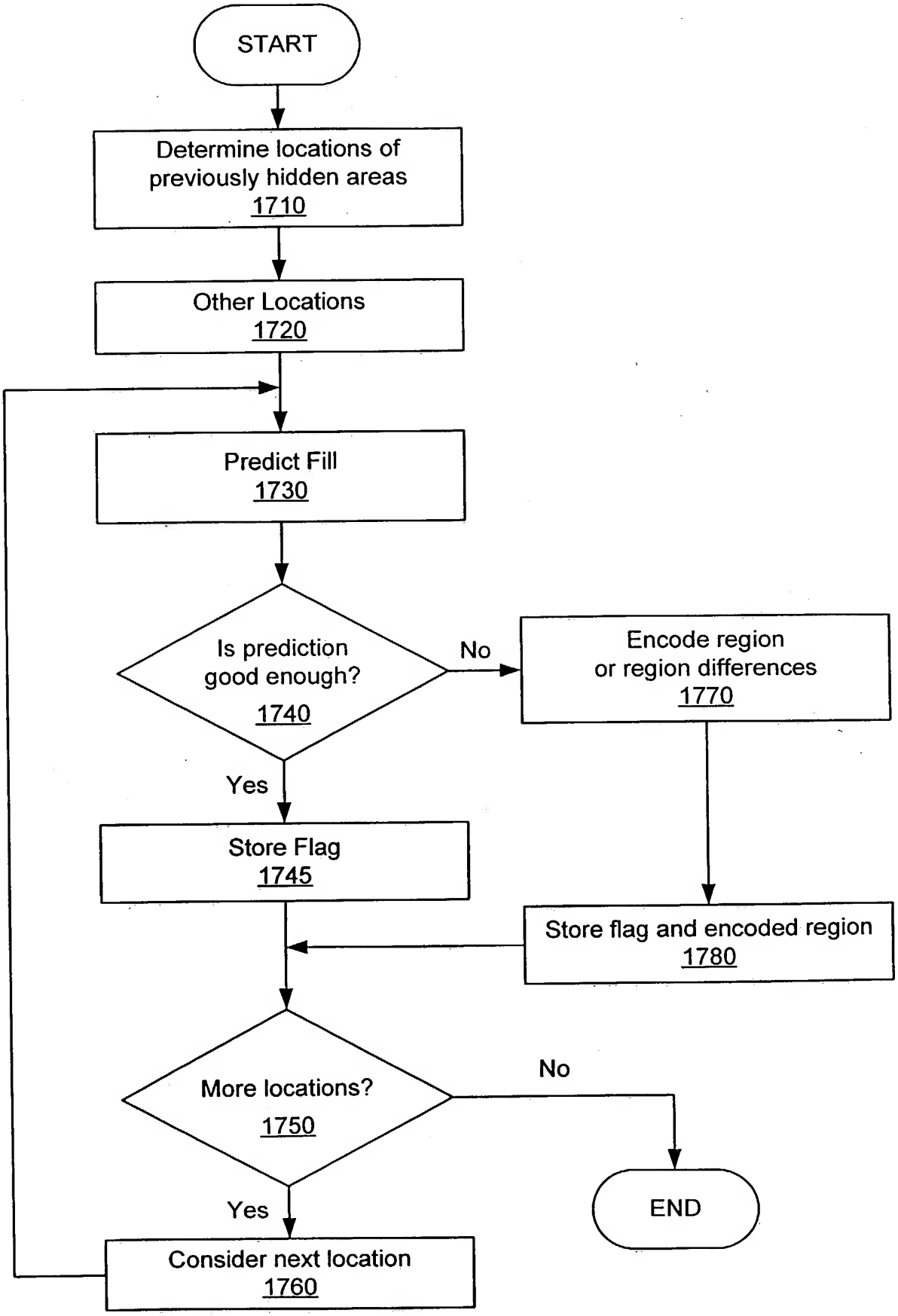
START
Determine locations of previously hidden areas 1710
Other Locations 1720
Predict Fill 1730
Is prediction good enough? 1740
No
Encode region or region differences 1770
Yes
Store Flag 1745
Store flag and encoded region 1780
More locations? 1750
No
END
Yes
Consider next location 1760

FIG. 17

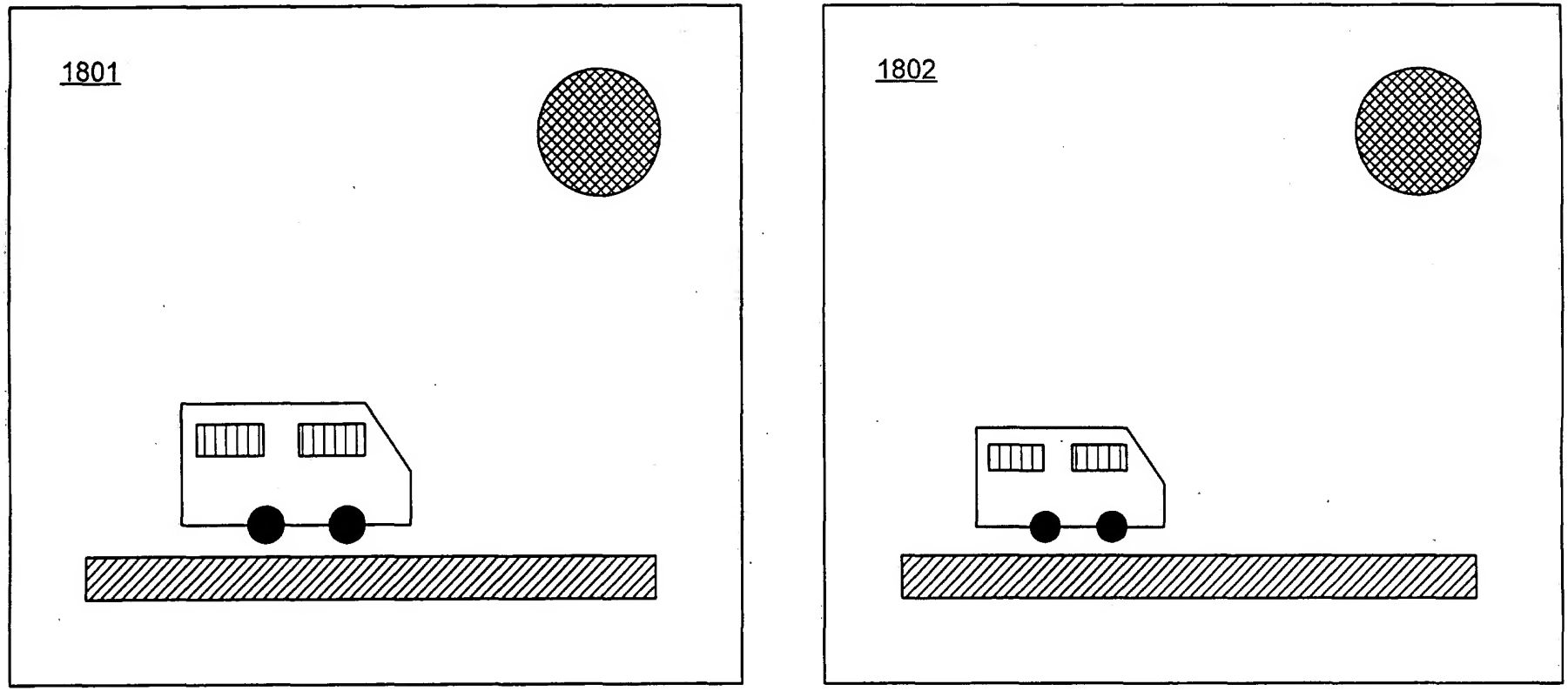


FIG. 18

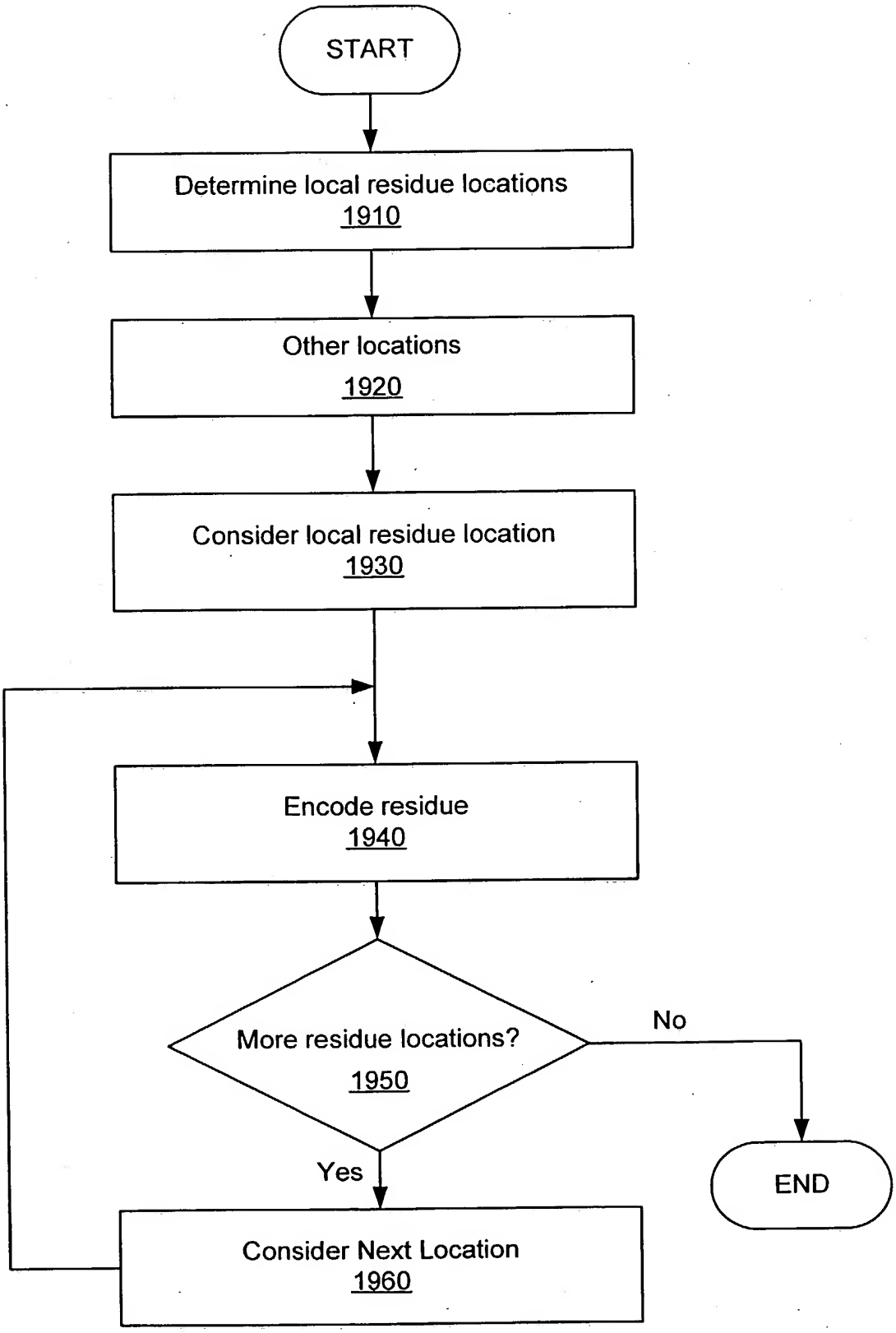
START
Determine local residue locations
1910
Other locations
1920
Consider local residue location
1930
Encode residue
1940
More residue locations?
1950
No
Yes
END
Consider Next Location
1960

FIG. 19

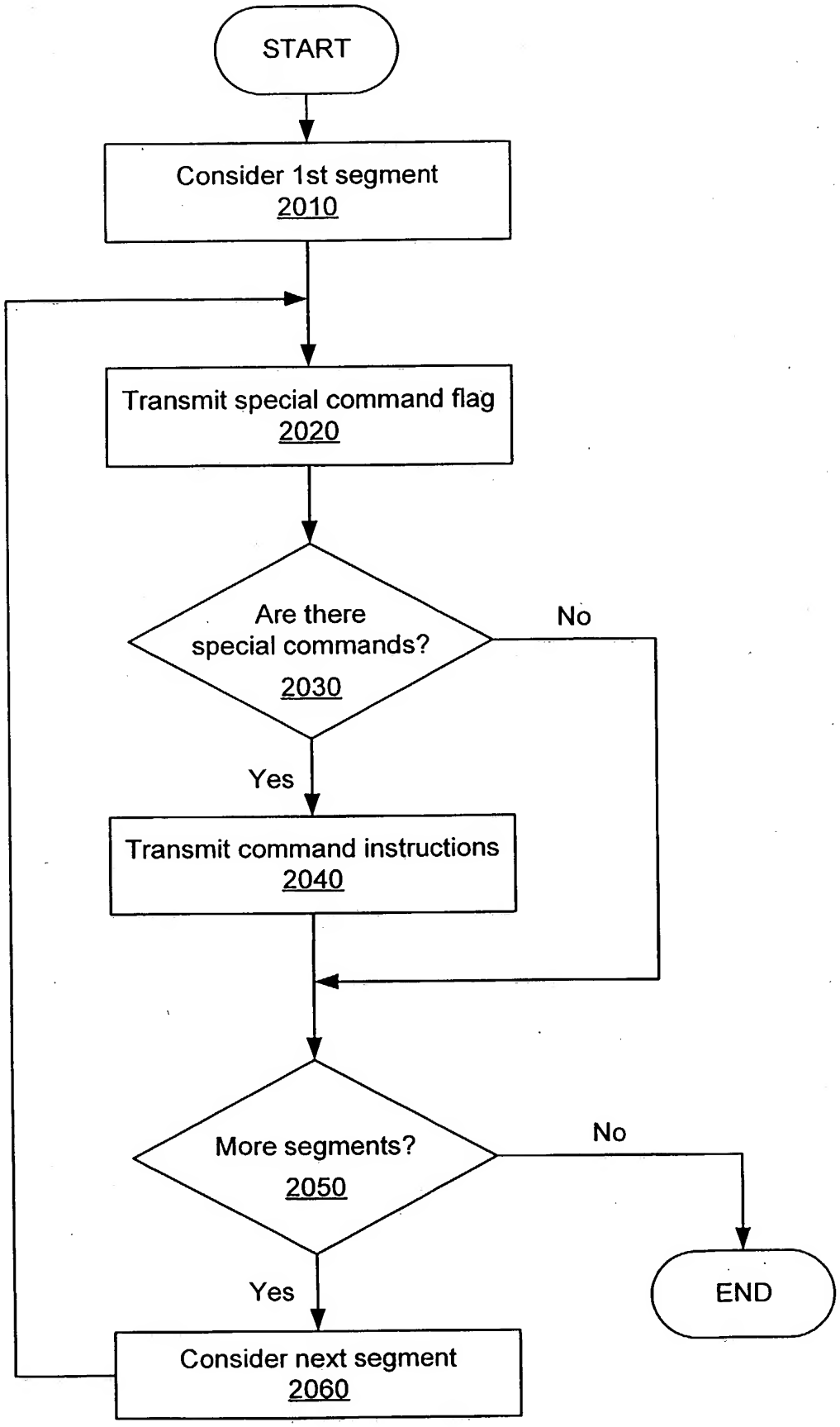
START
Consider 1st segment
2010
Transmit special command flag
2020
Are there
special commands?
2030
No
Yes
Transmit command instructions
2040
More segments?
2050
No
Yes
END
Consider next segment
2060

FIG. 20

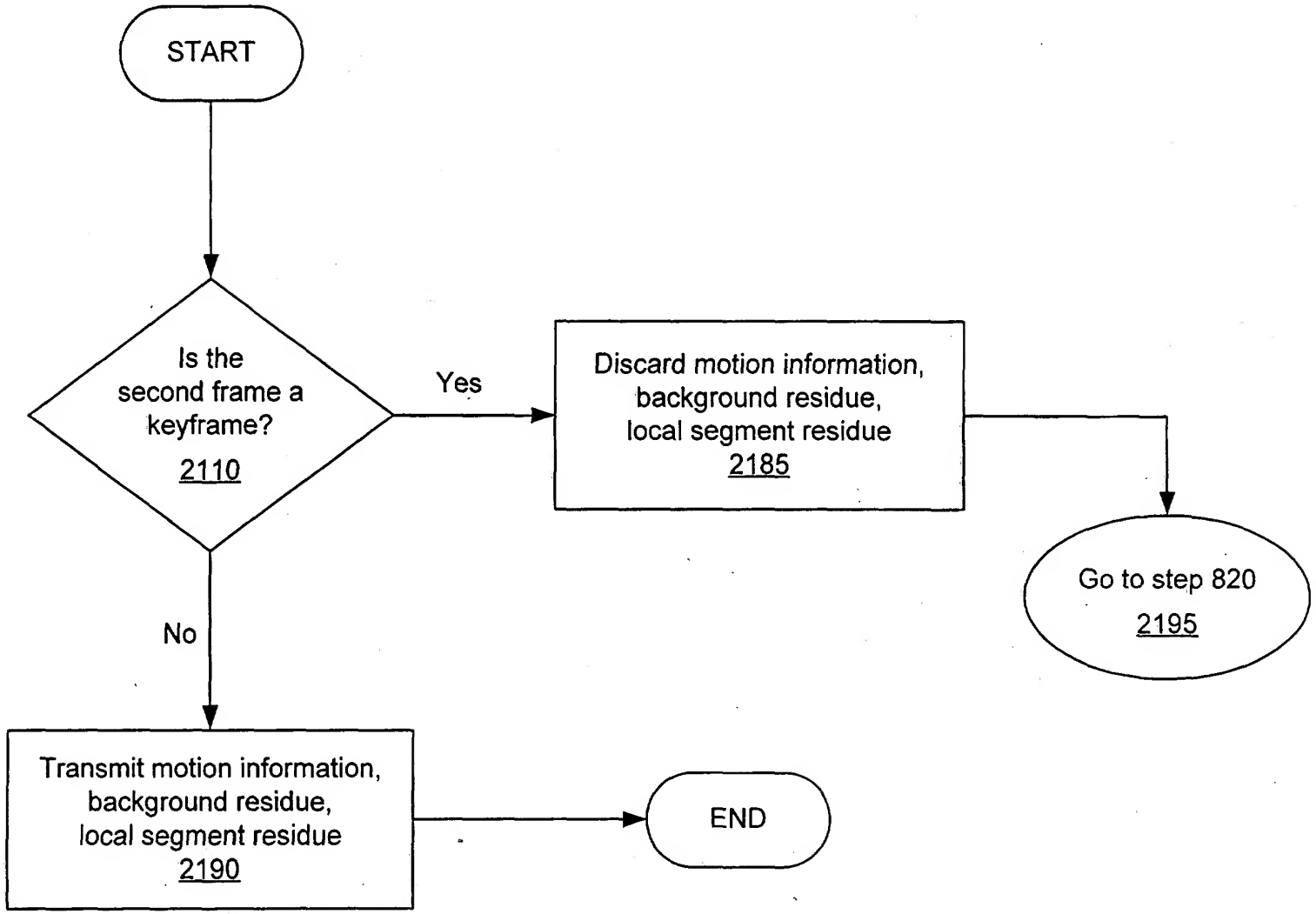
START
Is the second frame a keyframe?
2110
Yes
Discard motion information, background residue, local segment residue
2185
Go to step 820
2195
No
Transmit motion information, background residue, local segment residue
2190
END

FIG. 21

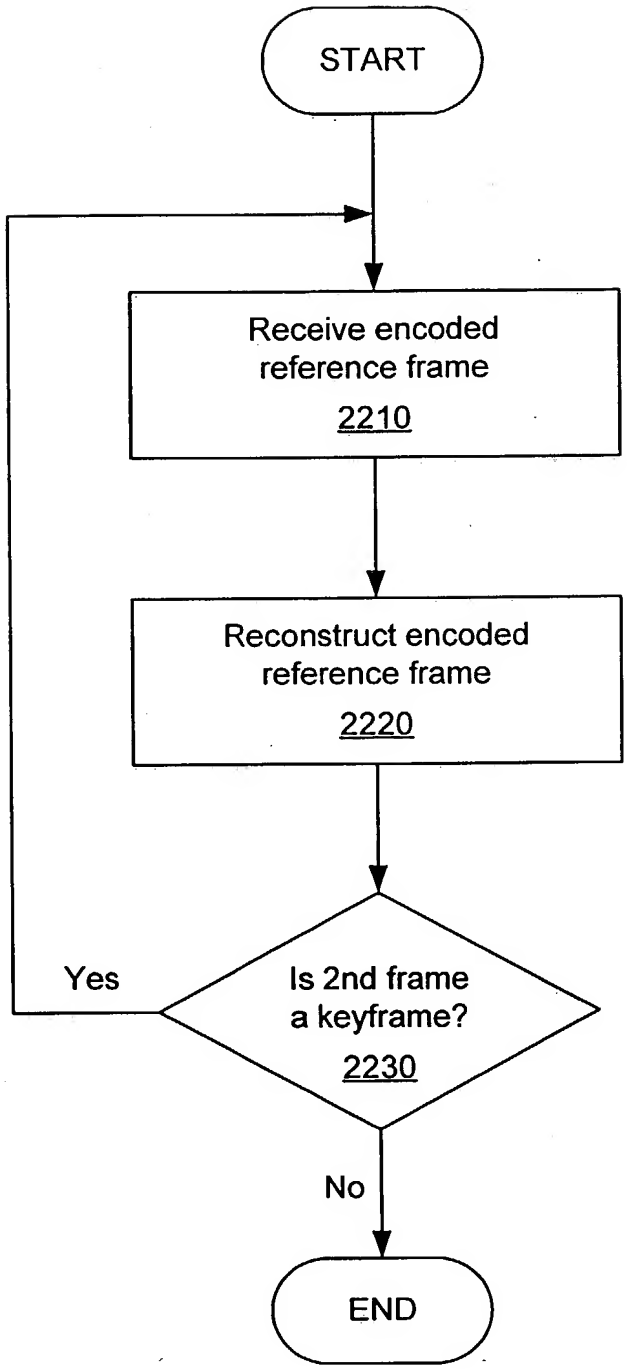
START
Receive encoded reference frame
2210
Reconstruct encoded reference frame
2220
Is 2nd frame a keyframe?
2230
Yes
No
END

FIG. 22

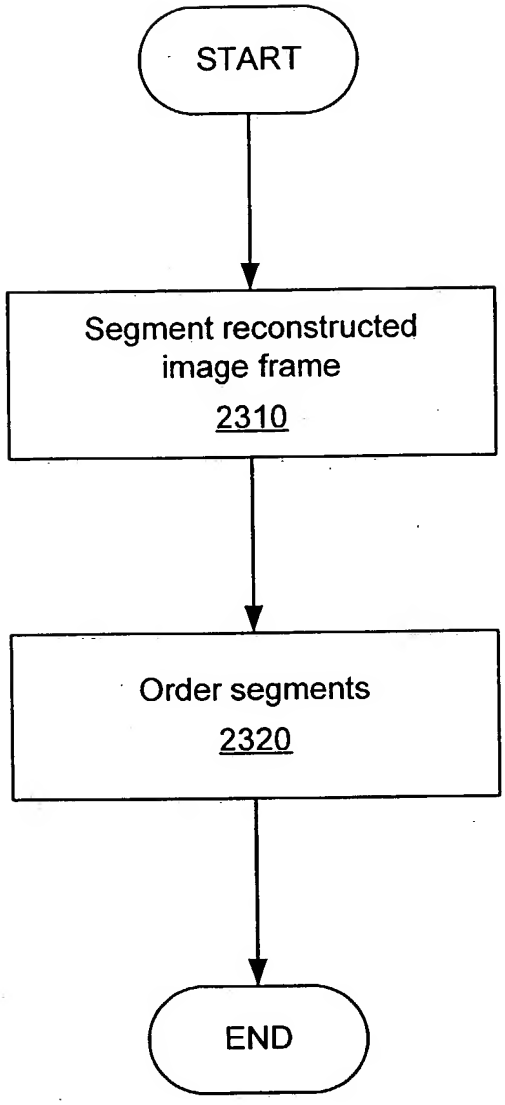
START
Segment reconstructed image frame
2310
Order segments
2320
END

FIG. 23

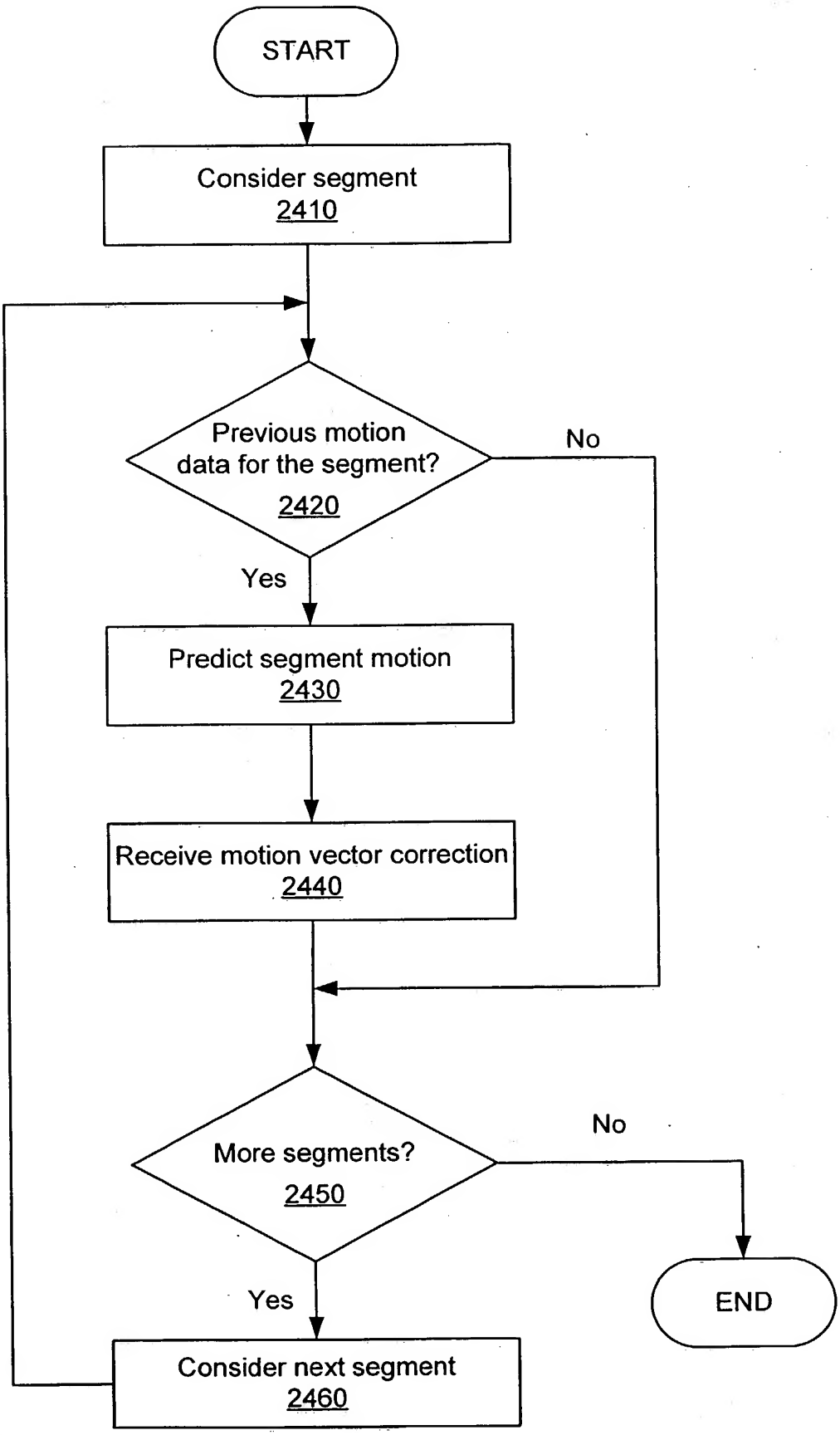
START
Consider segment
2410
Previous motion data for the segment?
2420
No
Yes
Predict segment motion
2430
Receive motion vector correction
2440
More segments?
2450
No
Yes
END
Consider next segment
2460

FIG. 24

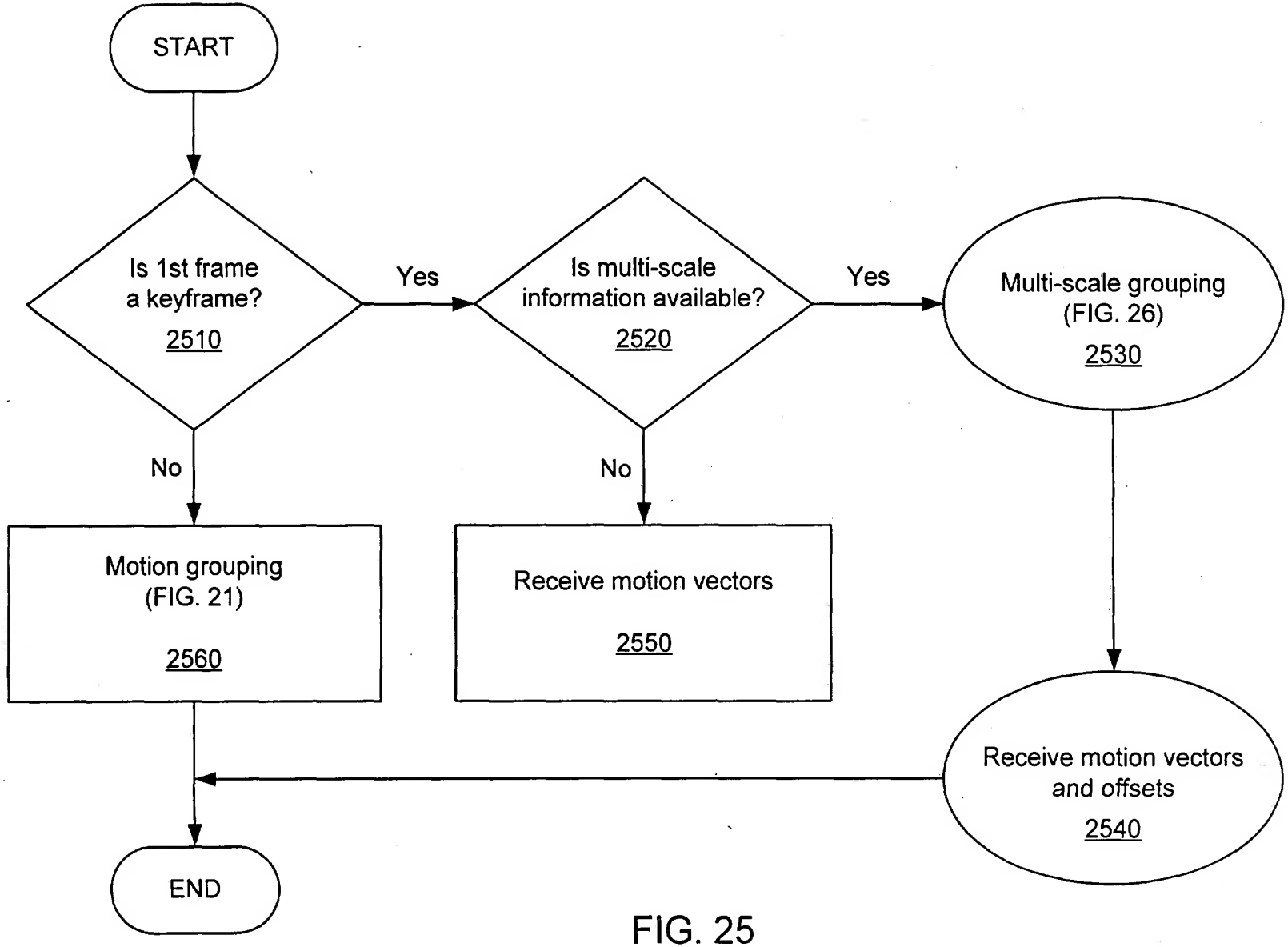
START
Is 1st frame a keyframe?
2510
Yes
Is multi-scale information available?
2520
Yes
Multi-scale grouping (FIG. 26)
2530
No
No
Motion grouping (FIG. 21)
2560
Receive motion vectors
2550
Receive motion vectors and offsets
2540
END

FIG. 25

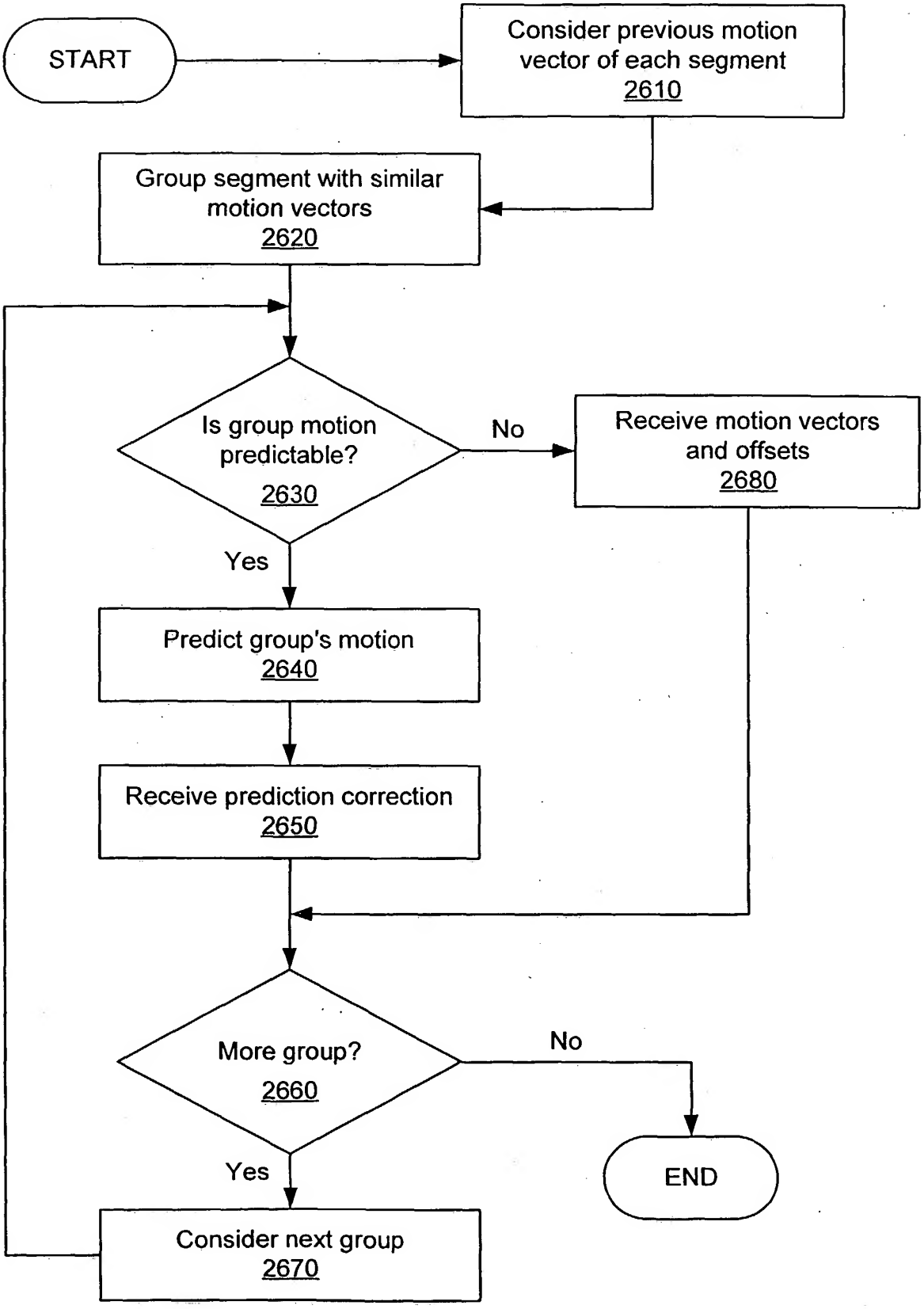
START
Consider previous motion vector of each segment
2610
Group segment with similar motion vectors
2620
Is group motion predictable?
2630
No
Receive motion vectors and offsets
2680
Yes
Predict group's motion
2640
Receive prediction correction
2650
More group?
2660
No
Yes
END
Consider next group
2670

FIG. 26

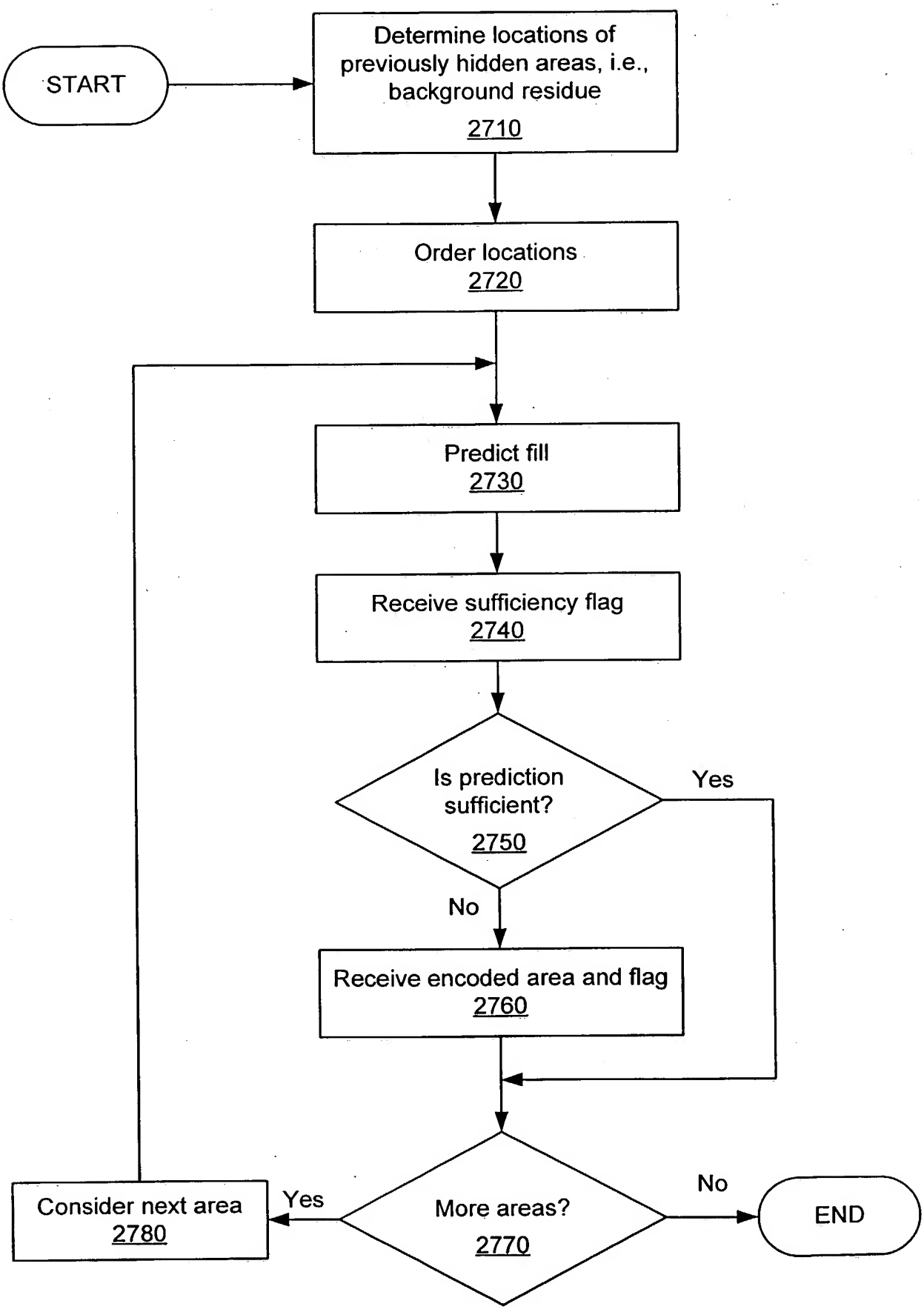
START
Determine locations of previously hidden areas, i.e., background residue
2710
Order locations
2720
Predict fill
2730
Receive sufficiency flag
2740
Is prediction sufficient?
2750
Yes
No
Receive encoded area and flag
2760
More areas?
2770
No
END
Yes
Consider next area
2780

FIG. 27

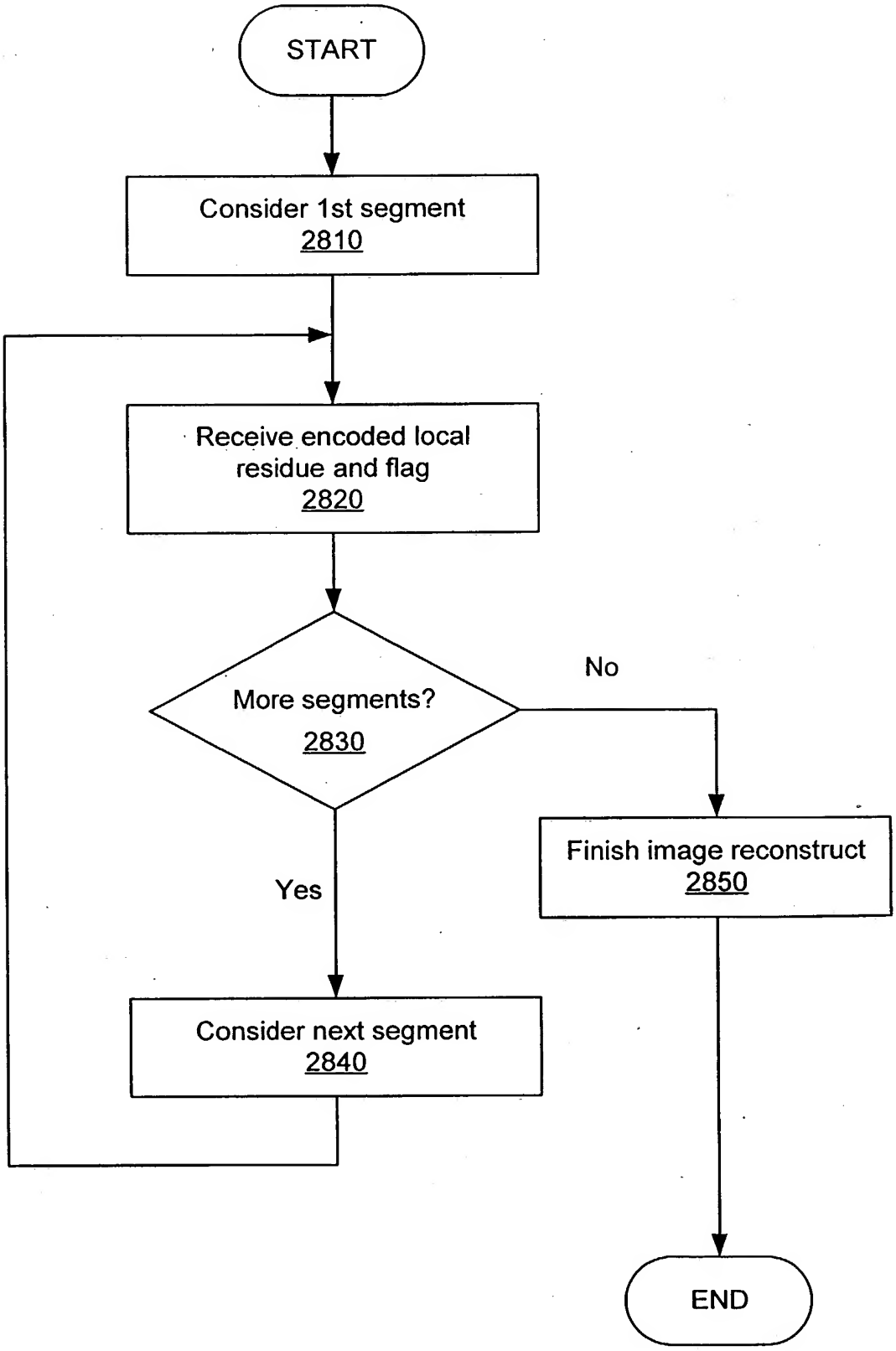
START
Consider 1st segment
2810
Receive encoded local residue and flag
2820
More segments?
2830
No
Yes
Finish image reconstruct
2850
Consider next segment
2840
END

FIG. 28

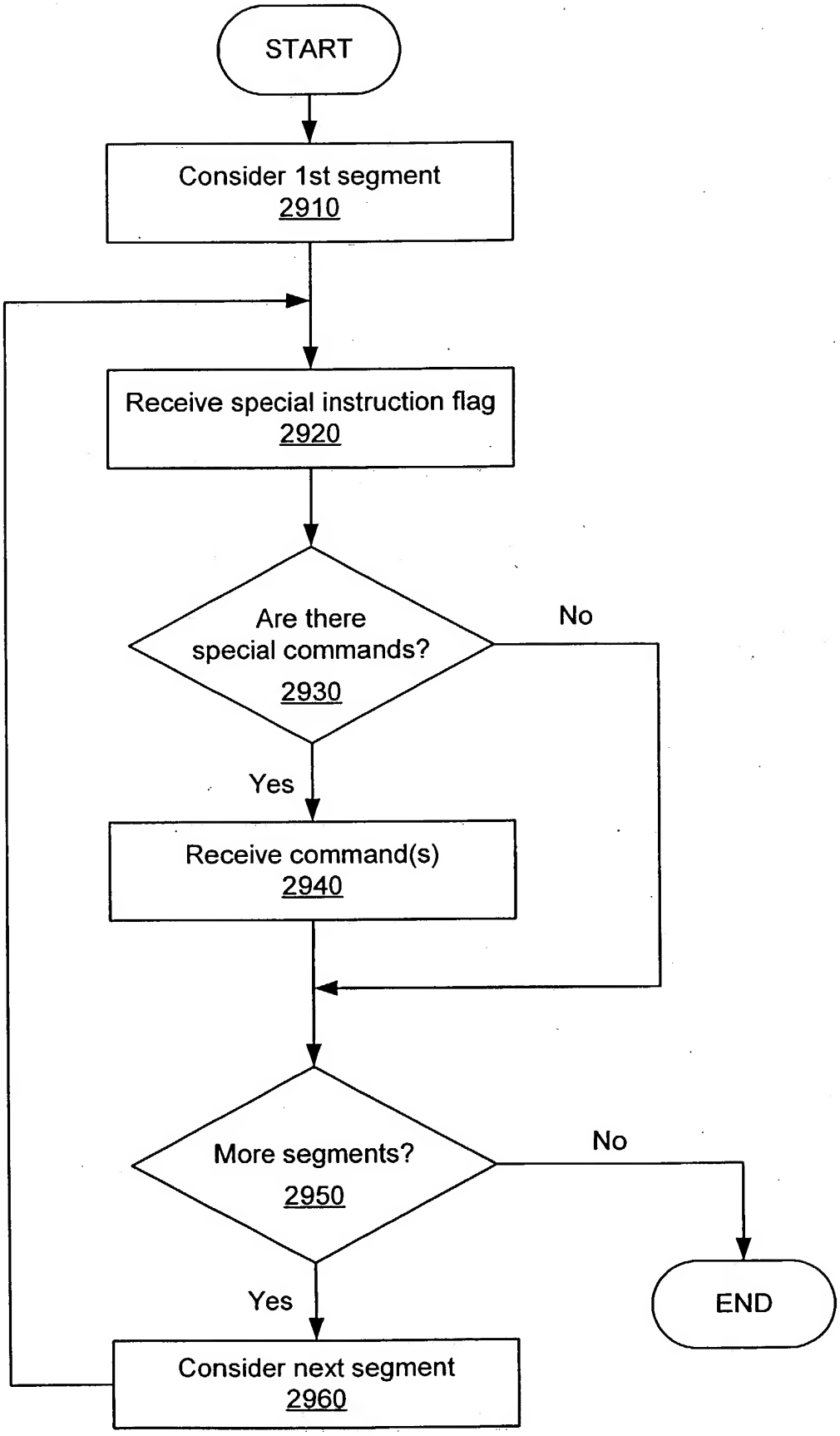
START
Consider 1st segment
2910
Receive special instruction flag
2920
Are there special commands?
2930
No
Yes
Receive command(s)
2940
More segments?
2950
No
Yes
END
Consider next segment
2960

FIG. 29

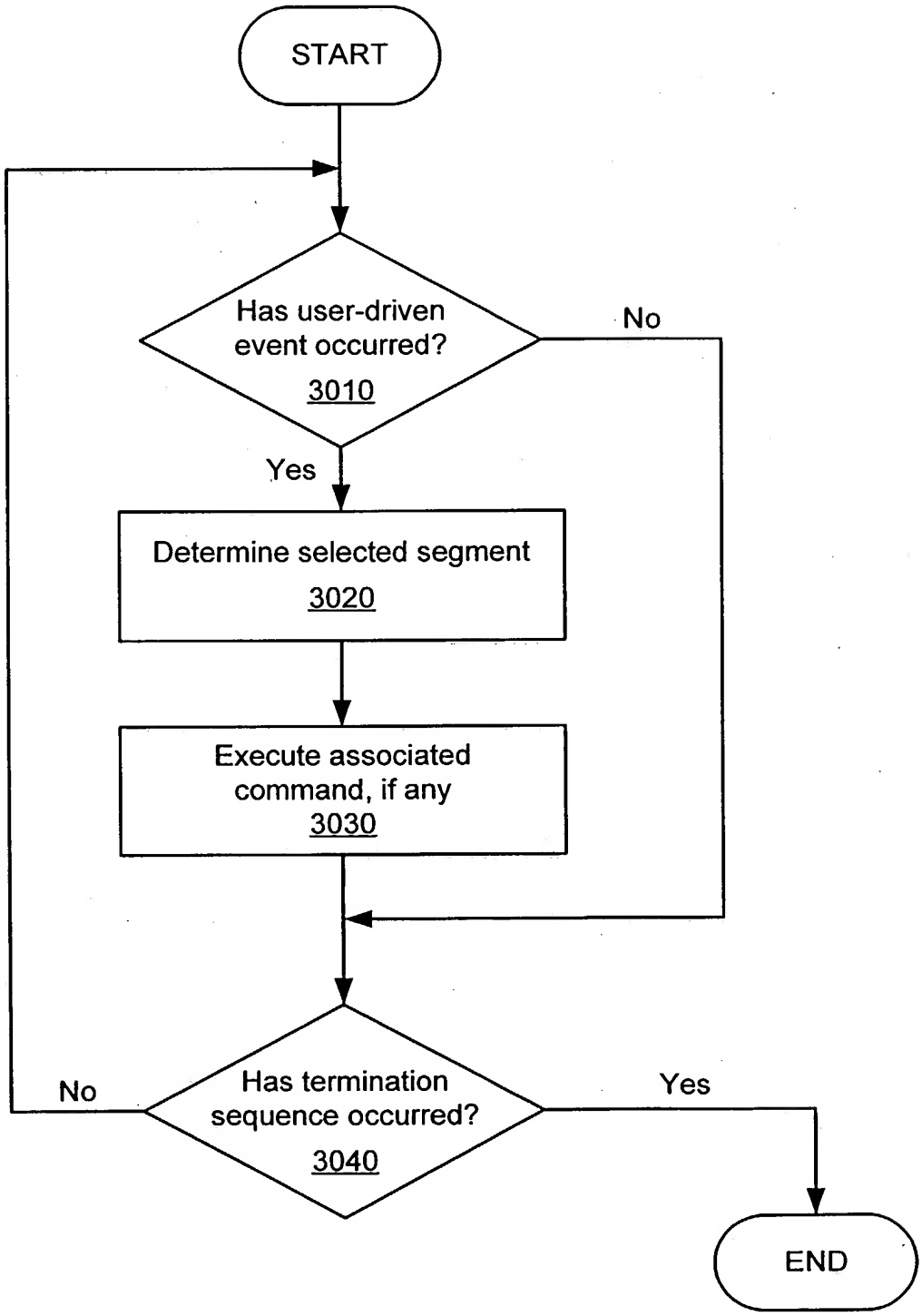
START
Has user-driven event occurred?
3010
No
Yes
Determine selected segment
3020
Execute associated command, if any
3030
Has termination sequence occurred?
3040
No
Yes
END

FIG. 30